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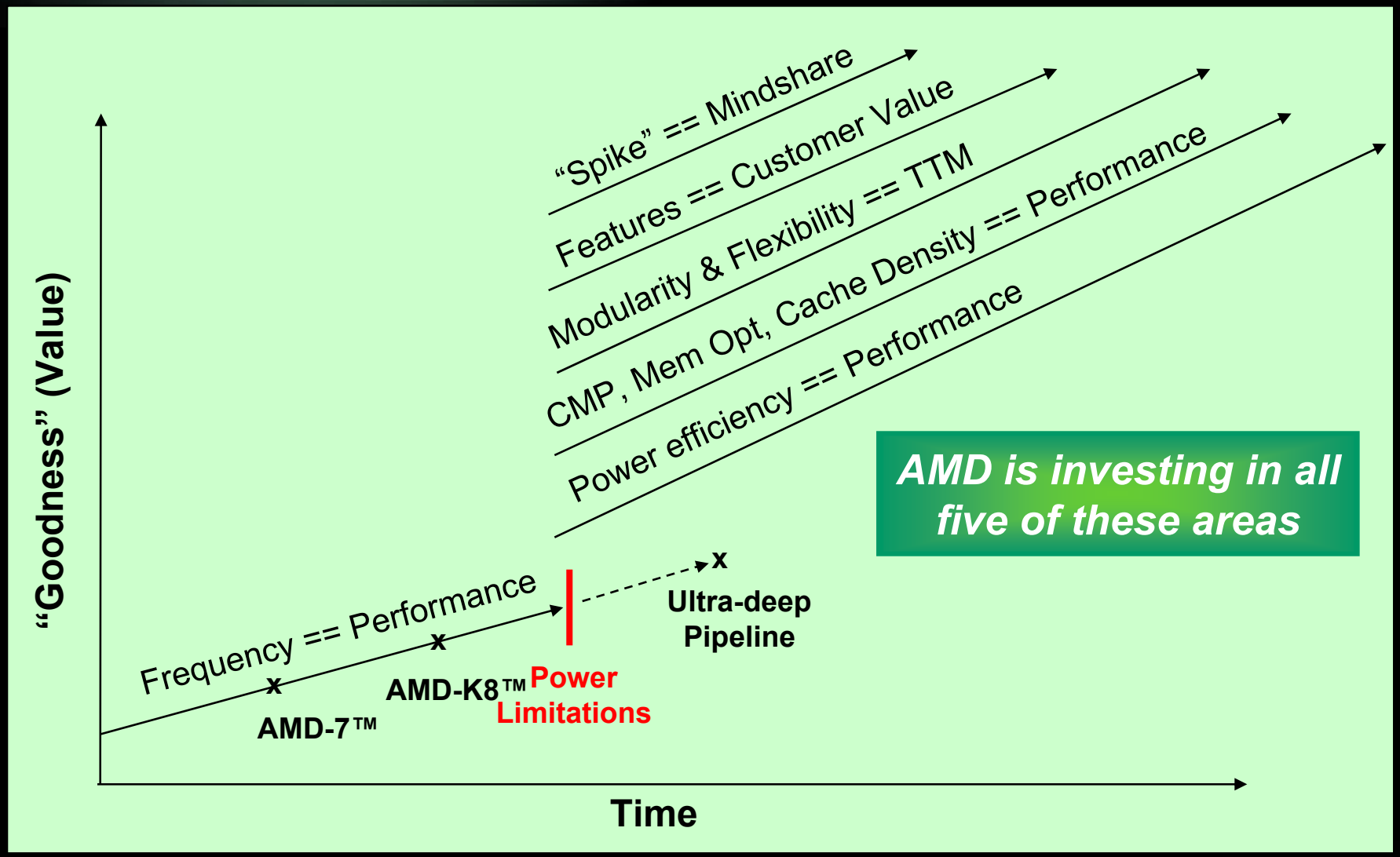
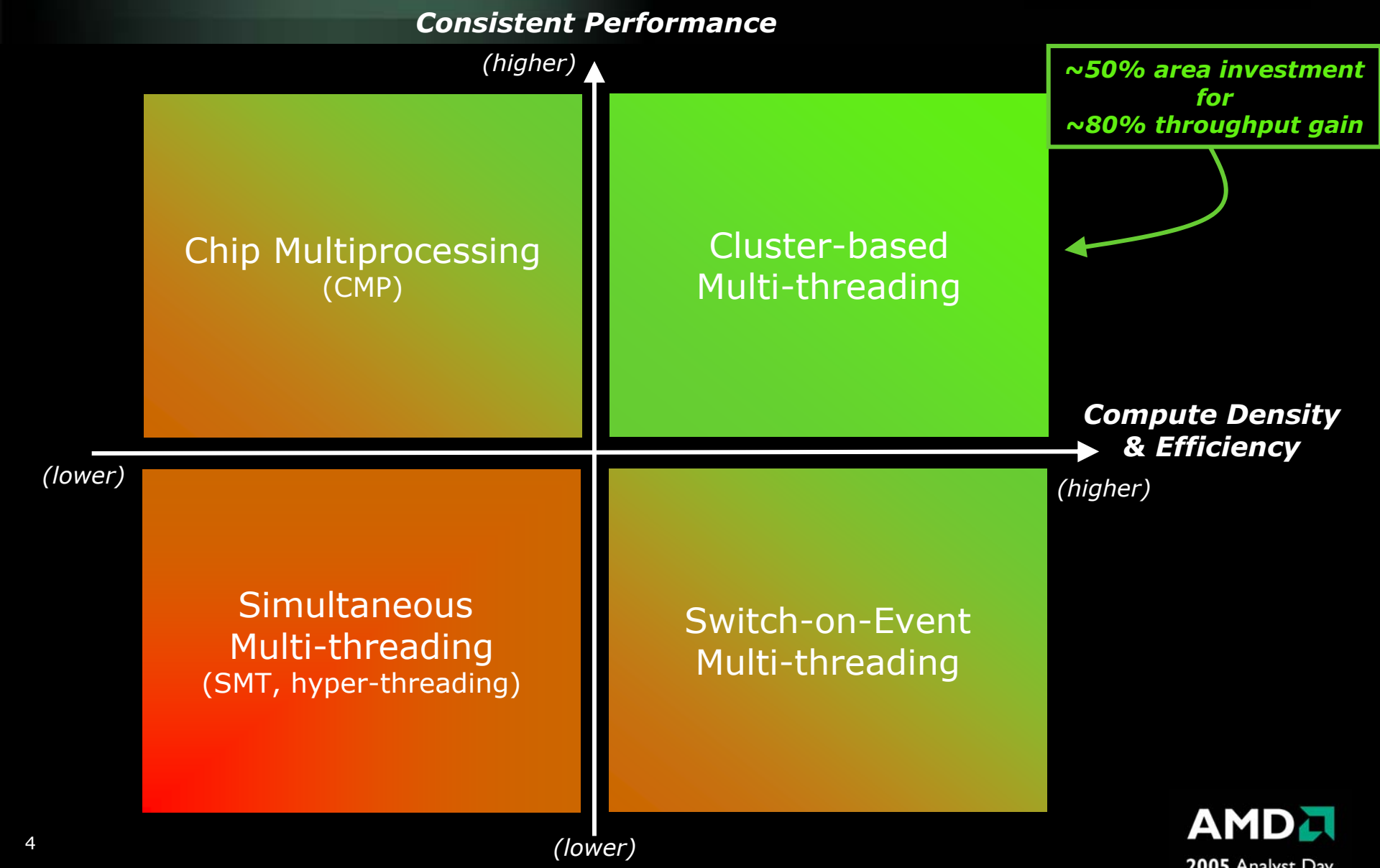
# Important Trends



# AMD Architectural Generations

| Now | Coming Soon | Future |
| --- | --- | --- |
| AMD64 Architecture | Extensions to AMD64 | FPU Extensions to AMD64 |
| Dual Core Architecture | Multi-core Architecture | Throughput Architecture |
| Direct Connect Architecture | Scalable SMP Architecture | On-chip Coprocessors |
| Enhanced Virus Protection | Pacifica Virtualization | Secure Execution |
| HyperTransport™ v1.0, v2.0 | HyperTransport v3.0 | HyperTransport v4.0 |
| DDR, DDR2 | DDR3, FBDIMM | DDR4, FBD2 |
| AMD PowerNow!™ Technology | Partitioned PowerNow! | System Resource Mgmnt |
| High Reliability RAS | Mainframe-class reliability | Best-in-class Reliability |
| *System Performance* | *System Perf. / Watt* | *Throughput / Watt / $$* |

# Multi-threading Done Right



# A Closer Look at *Parallelism*

AMD

## Instruction-level Parallelism (ILP)

- Executing multiple instructions from same program at the same time
- Superscalar hardware picks up most available ILP

## Data-level Parallelism (DLP)

- Executing same instruction on multiple pieces of data at the same time
- SSE hardware operates in this manner
- Also the basis for Vector Processors

## Thread-level Parallelism (TLP) – several types:

1. **Concurrent Applications**
   - Multiple programs running at the same time
   - Multiple OS's on virtualized hardware image
2. **Internet Transactional**
   - Multiple computers running the same application
3. **Parallel Applications**
   - Single application partitioned to run as multiple threads
   - ***The holy grail of computer science***

# The Transition to Parallel Applications

## Single-threaded Applications

- Most of today's applications
- Well understood optimization techniques
- Advanced development, analysis and debug tools
- Conceptually, easy to think about

## Parallel Applications

- Small number of applications (worked by experts for 10+ yrs)
- Awkward development, analysis and debug environments
- Parallel programming is hard!
- Amdahl's law is still a law
- SW productivity is already in a crisis → this worsens the problem!

Understanding the *appropriate rate of transition* is what will be important to real customers

# Power-efficient Design

- Power is a first-order constraint on all chip designs
  - Mobile – *battery life, heat dissipation, cost*
  - Desktop – *performance limited by TDP specifications*
  - Server – *multi-core designs push power up quickly*
- AMD is investing heavily Low Power Design techniques
  - Process technology, Circuits, Architecture, Methodologies
  - Techniques will be leveraged across the board
- AMD will make use of several different CPU core designs:
  - Value Core – *good enough* performance at a power budget
  - Performance Core – maximum performance and throughput
  - Pervasive Core – x86 everywhere!

# Summary

- AMD is focused on real customer requirements and value
  - Today, value goes way beyond just performance
  - AMD is focused on *customer-centric innovation* and *value*
- AMD is investing heavily in future design points
  - Next generation designs well underway and will extend our lead
  - Further generation designs already in the works as well
- Multi-core and Multi-threading are important for throughput
  - But, customers will continue to value increasing single-thread performance as well for many years to come

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